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審査請求　未請求　請求項の数１　ＦＤ　（全　３　頁）

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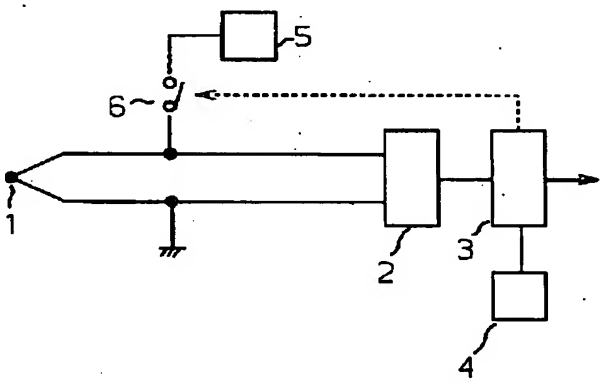
(54)【発明の名称】　熱電対劣化検知装置

(57)【要約】

【目的】簡易な構成で、容易に熱電対の劣化を検知、予知できる熱電対劣化検知装置を提供する。

【構成】熱電対１に所定の電流を断続的に供給する電流源５と、熱電対１による熱起電力から温度Ｔを測定し、あらかじめメモリ４に記憶された温度と熱電対１の抵抗値との関係から測定した温度に対応する抵抗値を算出し、前記熱電対に前記電流源５から電流を供給したときの電圧降下から熱電対１の抵抗値を測定し、この抵抗値と前記算出した抵抗値とを比較し熱電対１の劣化を検知する処理手段３とを備える。



【特許請求の範囲】
【請求項１】熱電対に所定の電流を断続的に供給する電流源と、前記熱電対による熱起電力から温度を測定し、あらかじめメモリに記憶された温度と熱電対の抵抗値との関係から測定した温度に対応する抵抗値を算出し、前記熱電対に前記電流源から電流を供給したときの電圧降下から熱電対の抵抗値を測定し、この抵抗値と前記算出した抵抗値とを比較し熱電対の劣化を検知する処理手段とを備えたことを特徴とする熱電対劣化検知装置。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】この発明は、熱電対の劣化を検知する装置に関するものである。
【０００２】
【従来の技術】熱電対は、加熱炉その他の温度測定に広く使用されている。ところが、高温雰囲気で長時間使用していると劣化するおそれがある。
【０００３】従来、劣化を検知する良い方法はなく、定期的に標準の熱電対と比較検定したり、経験的に所定時間使用する毎に定期的に交換していた。
【０００４】
【発明が解決しようとする課題】しかしながら、比較検定をする為には、高価な検定装置を用意する必要があり、検定の手間を大きく要し、また、熱電対を定期的に交換する場合では使用可能な熱電対まで交換することもあり無駄を生じるおそれがあった。
【０００５】この発明の目的は、以上の点に鑑み、簡易な構成で、容易に熱電対の劣化を検知、予知できる熱電対劣化検知装置を提供することである。
【０００６】
【課題を解決するための手段】この発明は、熱電対に所定の電流を断続的に供給する電流源と、前記熱電対による熱起電力から温度を測定し、あらかじめメモリに記憶された温度と熱電対の抵抗値との関係から測定した温度に対応する抵抗値を算出し、前記熱電対に前記電流源から電流を供給したときの電圧降下から熱電対の抵抗値を測定し、この抵抗値と前記算出した抵抗値とを比較し熱電対の劣化を検知する処理手段とを備えるようにした熱電対劣化検知装置である。
【０００７】
【実施例】図１は、この発明の一実施例を示す構成説明図である。図１において、１は先端部が測定対象に設けられた熱電対で、この熱電対１からの熱起電力は、増幅器、Ａ／Ｄ変換器等を含む測定手段２で測定され、この測定電圧は処理手段３に供給される。μＣＰＵ等よりなる処理手段３は、あらかじめメモリ４に記憶された熱電対の種類により定められた通常の熱起電力と温度との第１の関係を用い、測定電圧から温度に換算する演算処理を行い温度出力を取り出すことができる。また、処理手段３により必要時あるいは定期的に所定の間隔でスイッチ手段６をオンとし、電流源５の所定の電流を熱電対１に供給し、このときの電圧降下分を測定手段２で測定して処理手段３に供給し、処理手段３で熱電対１の抵抗値を測定する。そして、処理手段３は、あらかじめメモリ４に記憶された温度と熱電対の抵抗値との第２の関係から熱電対１で先に測定した温度に対応する抵抗値を算出し、この算出した抵抗値と熱電対１に電流源５から電流を供給したときの電圧降下から求めた熱電対の抵抗値と比較し、熱電対１の劣化を検知する。
【０００８】つまり、図２の実線Ａで示すように、メモリ４には、通常の熱起電力と温度との第１の関係の他に、測定温度Ｔと、そのときの熱電対の抵抗値Ｒ、またはある温度Ｔ０のときの抵抗Ｒ０で割った抵抗比Ｒ／Ｒ０との上記第２の関係を記憶・格納しておく。そして、各温度に対し、点線Ｂ、Ｃで示す所定の抵抗値幅の限界レベル（例えば±１０％）を設け、これを越えたとき、劣化と判断すればよい。勿論、抵抗と電圧は比例するので、電圧値と温度を比較してもよい。なお、この抵抗比Ｒ／Ｒ０は、熱電対の種類により一定であるので、抵抗比Ｒ／Ｒ０を用いることにより、熱電対の長さ、太さ等の影響を受けることがない。また、適正な基準温度Ｔ０との温度比Ｔ／Ｔ０を用いるようにすれば、特性を格納せず、係数のみで済む。
【０００９】以上のことから、熱電対１の熱起電力を測定手段２で測定し、上記第１の関係から処理手段３で温度Ｔを測定し、あらかじめメモリ４に記憶された温度と熱電対の抵抗値との上記第２の関係から温度Ｔに対応した抵抗値Ｒｒを算出しておく。次にスイッチ手段６をオンとし、電流源５から熱電対１に所定の電流ｉを断続的に供給し、供給したときの電圧降下から熱電対１の抵抗値Ｒを測定する。そして、この抵抗値Ｒと測定温度Ｔに対応する抵抗値Ｒｒとを処理手段３で比較し熱電対１の劣化を検知する。例えば、図２で示すように、抵抗値Ｒが限界レベルＢ、Ｃを越えたとき、劣化してきているとの警報、予知情報を出力する。
【００１０】ここで、電流源５より熱電対１に電流ｉを流したとき、温度Ｔとされる熱電対１の抵抗値をＲ、それ以外の部分の補償導線等の部分の抵抗値をＲ１、温度Ｔのときの熱起電力をＶ０とすると測定電圧Ｖ１は次式となる。
【００１１】

$$V1=V0+i\ (R+R1)=i\cdot R+(V0+i\cdot R1) \qquad (1)$$

これより

$$R=[V1-(V0+i\cdot R1)]/i \qquad (2)$$

が求まる。ここで、（Ｖ０＋ｉ・Ｒ１）は、十分小さければ無視でき、あるいはＶ０は通常の測定により求ま

り、電流値ｉは設定値であり、抵抗値Ｒ１は、補償導線等の種類により既知である。この補正して求められた抵抗値Ｒを用いて上記温度と熱電対の抵抗値との第２の関係等を用いて同様に劣化検知を行うことができる。

【００１２】この他に、実際の稼働時に温度上昇させて、所定時間、あるいは所定温度、あるいは必要な場合にスイッチ手段６を断続させ、熱電対１の熱起電力による温度Ｔと、そのときの抵抗値を求め、処理手段３によりメモリ４にこれらの関係を図２のような第２の関係として格納し、上記劣化検知を行ってもよい。

【００１３】

【発明の効果】以上述べたように、この発明は、熱電対に所定の電流を断続的に供給する電流源と、前記熱電対による熱起電力から温度を測定し、あらかじめメモリに記憶された温度と熱電対の抵抗値との関係から測定した温度に対応する抵抗値を算出し、前記熱電対に前記電流源から電流を供給したときの電圧降下から熱電対の抵抗値を測定し、この抵抗値と前記算出した抵抗値とを比較し熱電対の劣化を検知する処理手段とを備えるようにした熱電対劣化検知装置である。このため、常時、熱電対の抵抗値変化から、熱電対の劣化を検知、予知することができ、しかも、そのときの測定温度に対応した基準の抵抗値と比較しているので、熱電対がどのような温度で測定していたとしても、十分に劣化の検知が可能となる。また、抵抗の他に抵抗比と温度との関係を用いることで、熱電対の長さ、太さ等の影響を受けることがない。また、実際の稼働時に温度上昇させて、熱電対の熱起電力による温度と、そのときの抵抗値を求め、これの関係を用いて、劣化検知をすれば、種々の補正演算は不要となる。また、熱電対が複数チャンネルの場合、入力切換器で各チャンネルの入力取り込み毎に抵抗値測定を行って、各熱電対毎の劣化検知が可能となる。

【図面の簡単な説明】

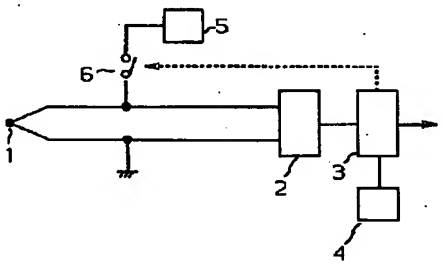
【図１】この発明の一実施例を示す構成説明図である。

【図２】この発明の一実施例を示す動作説明図である。

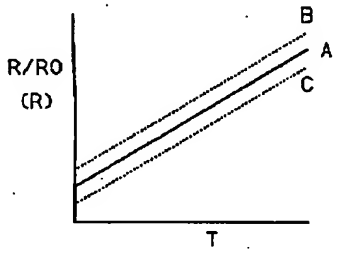
【符号の説明】

1　熱電対
2　測定手段
3　処理手段
4　メモリ
5　電流源
6　スイッチ手段

【図１】



【図２】



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(71) Applicant: **CHINO CORP**

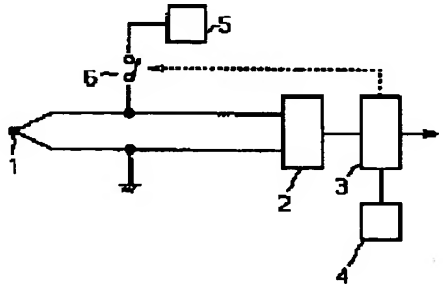
(72) Inventor: **HISHIKARI ISAO**
HOSOYA YUKIKOTO

(54) DETECTING DEVICE OF DETERIORATION OF THERMOCOUPLE

(57) Abstract:

PURPOSE: To obtain a detecting device of deterioration of a thermocouple which can detect and predict deterioration of the thermocouple easily, by a simple construction.

CONSTITUTION: This device is equipped with a current source 5 which supplies a prescribed current intermittently to a thermocouple 1 and with a processing means 3 which measures a temperature T from a thermoelectromotive force generated by the thermocouple 1, calculates a resistance value corresponding to the measured temperature from the relation between a temperature and the resistance value of the thermocouple 1 stored beforehand in a memory 4, measures the resistance value of the thermocouple 1 from a voltage drop at the time when the current is supplied to the thermocouple 1 from the current source 5, compares this resistance value with the calculated resistance value and detects deterioration of the thermocouple 1 therefrom.



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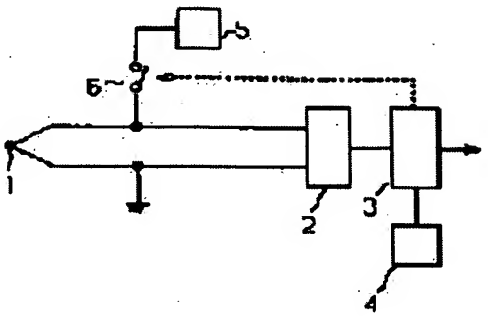

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[Date of requesting appeal against examiner's decision of rejection]

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3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Thermocouple degradation detection equipment characterized by providing the following. The current source which supplies predetermined current to a thermocouple intermittently A processing means to compute the resistance corresponding to the temperature which measured temperature from the thermoelectromotive force by the aforementioned thermocouple, and was measured from the relation between the temperature beforehand memorized by memory and the resistance of a thermocouple, to measure the resistance of a thermocouple from the voltage drop when supplying current to the aforementioned thermocouple from the aforementioned current source, to compare this resistance with the resistance which carried out [aforementioned] calculation, and to detect degradation of a thermocouple

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[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the equipment which detects degradation of a thermocouple.
[0002]
[Description of the Prior Art] The thermocouple is widely used for the thermometry of a heating furnace and others. However, there is a possibility of deteriorating if it is used in elevated-temperature atmosphere for a long time.
[0003] Conventionally, there was no good method of detecting degradation, and whenever it carried out comparison official approval with the standard thermocouple periodically or it carried out predetermined-time use experientially, they were exchanged periodically.
[0004]
[Problem(s) to be Solved by the Invention] However, by the case where it is necessary to prepare expensive official approval equipment, and require the time and effort of official approval greatly, and thermocouples are exchanged periodically, in order to carry out comparison official approval, since even the usable thermocouple was exchanged, there was a possibility of producing futility.
[0005] The purpose of this invention is offering the thermocouple degradation detection equipment which is simple composition, and can detect and foreknow degradation of a thermocouple easily in view of the above point.
[0006]
[Means for Solving the Problem] This invention measures temperature from the current source which supplies predetermined current to a thermocouple intermittently, and the thermoelectromotive force by the aforementioned thermocouple. The resistance corresponding to the temperature measured from the relation between the temperature beforehand memorized by memory and the resistance of a thermocouple is computed. It is thermocouple degradation detection equipment equipped with a processing means to measure the resistance of a thermocouple from the voltage drop when supplying current to the aforementioned thermocouple from the aforementioned current source, to compare this resistance with the resistance which carried out [aforementioned] calculation, and to detect degradation of a thermocouple.
[0007]
[Example] Drawing 1 is composition explanatory drawing showing one example of this invention. In drawing 1 , 1 is the thermocouple with which the point was prepared in the measuring object, the thermoelectromotive force from this thermocouple 1 is measured with the measurement means 2 containing amplifier, an A/D converter, etc., and this measurement voltage is supplied to the processing means 3. The processing means 3 which consists of a muCPU etc. can perform data processing converted into temperature from measurement voltage using the 1st relation of the usual thermoelectromotive force and temperature which were defined according to the kind of thermocouple beforehand memorized by memory 4, and can take out a temperature output. Moreover, by the

processing means 3, when required, switching means 6 are periodically set to ON at the predetermined intervals, the predetermined current of a current source 5 is supplied to a thermocouple 1, a part for the voltage drop at this time is measured with the measurement means 2, the processing means 3 is supplied and the resistance of a thermocouple 1 is measured with the processing means 3. And the processing means 3 computes the resistance corresponding to the temperature previously measured with the thermocouple 1 from the 2nd relation between the temperature beforehand memorized by memory 4 and the resistance of a thermocouple, and detects degradation of a thermocouple 1 as compared with the resistance of the thermocouple for which it asked from the voltage drop when supplying current to this resistance and thermocouple 1 that were computed from a current source 5.

[0008] That is, as the solid line A of drawing 2 shows, the 2nd relation of the above with resistance ratio R/R0 broken by the resistance R0 at the time of the measurement temperature T, and the resistance R of the thermocouple at that time or a certain temperature T0 other than the 1st relation between the usual thermoelectromotive force and temperature is memorized and stored at memory 4. And what is necessary is just to judge it as degradation, when the marginal level (for example, **10%) of the predetermined resistance width of face shown by dotted lines B and C is prepared to each temperature and this is exceeded. Of course, since resistance is proportional to voltage, you may measure a voltage value and temperature. In addition, this resistance ratio R/R0 is not influenced of the length of a thermocouple, a size, etc. by using resistance ratio R/R0 according to the kind of thermocouple, since it is fixed. Moreover, if thermal-ratio T/T0 with the proper reference temperature T0 is used, a property will not be stored but only a coefficient will be required.

[0009] From the above thing, the thermoelectromotive force of a thermocouple 1 is measured with the measurement means 2, temperature T is measured with the processing means 3 from the 1st relation of the above, and the resistance Rr corresponding to temperature T is computed from the 2nd relation of the above between the temperature beforehand memorized by memory 4 and the resistance of a thermocouple. Next, switching means 6 are set to ON and the resistance R of a thermocouple 1 is measured from the voltage drop when supplying predetermined current i to a thermocouple 1 intermittently from a current source 5, and supplying it to it. And the processing means 3 compares this resistance R and the resistance Rr corresponding to the measurement temperature T, and degradation of a thermocouple 1 is detected. For example, as drawing 2 shows, when resistance R exceeds the marginal level B and C, an alarm that it is deteriorating, and disaster prediction data are outputted.

[0010] Here, if thermoelectromotive force at the time of R1 and temperature T is set [the resistance of the thermocouple 1 made into temperature T] to V0 for the resistance of portions, such as compensating lead wire of R and the other portion, when Current i is passed from a current source 5 to a thermocouple 1, the measurement voltage V1 will serve as the following formula.

[0011]

$V1=V0+i(R+R1) = i\text{-}R+ (V0+i\text{-}R1)$ (1)

This $R= [V1- (V0+i\text{-}R1)] /i$ (2)

********. Here, if (V0+i-R1) is small enough, it can ignore, or V0 can be found by the usual measurement, current value i is the set point and resistance R1 is known by kinds, such as compensating lead wire. Degradation detection can be similarly performed using the 2nd relation between the above-mentioned temperature and the resistance of a thermocouple etc. using this resistance R amended and calculated.

[0012] In addition, a temperature rise is carried out at the time of actual operation, a predetermined time, predetermined temperature, or when required, switching means 6 may be made intermittent, the temperature T by the thermoelectromotive force of a thermocouple 1 and the resistance at that time may be calculated, these relations may be stored in memory 4 as the 2nd relation like drawing 2 by the processing means 3, and the above-mentioned degradation detection may be performed.

[0013]

[Effect of the Invention] The current source which was described above and by which this invention supplies predetermined current to a thermocouple intermittently like, The resistance corresponding to the temperature which measured temperature from the thermoelectromotive force by the aforementioned

thermocouple, and was measured from the relation between the temperature beforehand memorized by memory and the resistance of a thermocouple is computed. It is thermocouple degradation detection equipment equipped with a processing means to measure the resistance of a thermocouple from the voltage drop when supplying current to the aforementioned thermocouple from the aforementioned current source, to compare this resistance with the resistance which carried out [aforementioned] calculation, and to detect degradation of a thermocouple. For this reason, since degradation of a thermocouple can be detected and foreknown and it is moreover always comparing with the resistance of the criteria corresponding to the measurement temperature at that time from the change in resistance of a thermocouple, though the thermocouple has measured at what temperature, it becomes detectable [enough / degradation]. Moreover, it is not influenced of the length of a thermocouple, a size, etc. by using the relation between resistance ratio and temperature other than resistance. Moreover, if a temperature rise is carried out at the time of actual operation, the temperature by the thermoelectromotive force of a thermocouple and the resistance at that time are calculated and degradation detection is carried out using the relation of this, various amendment operations will become unnecessary. Moreover, when the number of thermocouples is [two or more], resistance measurement is performed for every input incorporation of each channel by the input scanner, and the degradation detection for every thermocouple is attained.

[Translation done.]